INDIA'S FIRST VEGETABLE BIOTECH CROP: BT BRINJAL

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INTRODUCTION

Brinjal also known as eggplant, is often described as a poor man's vegetable because it is popular amongst small-scale farmers and low income consumers. It is an important cash crop for more than 1.4 million small, marginal and resource-poor farmers. A poor man's crop it might be, but brinjal is also called by some as the 'King of Vegetables'. Major brinjal producing states include: West Bengal (30% production share), Orissa (20%), and Gujarat and Bihar (around 10% each). It is grown on nearly 7,00,000 hectares in India, making the country the second largest producer after China with a 26% world production share. In 2012-2013, the national average productivity of brinjal was recorded around 17.4 tons per hectare. It is a very good source of fiber, calcium, phosphorus, folic acid and vitamins B and C. It is also used in ayurvedic medicine for curing diabetes, hypertension and obesity. In addition, dried brinjal shoots are used as fuel in rural areas. Thus, brinjal has entrenched itself intensely into the Indian culture.

Brinjal is prone to attack from insect pests and diseases, the most serious and destructive of which is the fruit and shoot borer (FSB) *Leucinode sorbonalis*. FSB feeds predominantly on brinjal and is prevalent in all brinjal producing states. FSB larvae bore into tender shoots and fruits, retarding plant growth, making the fruits incompatible for the market and unhealthy for human consumption. Fruit damage as high as 95% and losses of up to 70% in commercial plantings have been reported. Therefore, farmers tend to over-spray insecticides, because they rely mainly on the subjective assessments of the visual presence of the pest. In addition to the financial cost associated with indiscriminate insecticide applications and its negative effects on the environment, high pesticide residues in vegetables and fruits pose serious risk to consumer's health and safety.

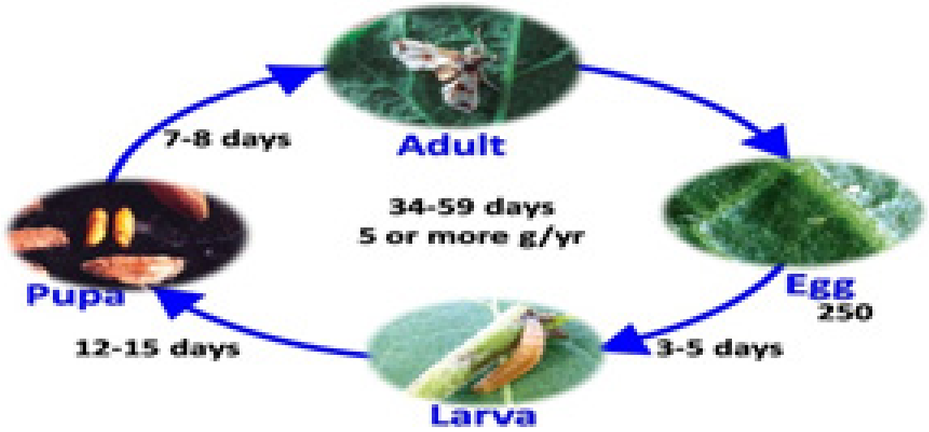

Figure 1: Life cycle of brinjal shoot and fruit borer.

HOW BT BRINJAL IS DEVELOPED?

FSB-resistant brinjal or Bt brinjal was developed using a transformation process similar to the one used in the development of Bt cotton, a biotech crop. Bt brinjal incorporates the cry1Ac gene expressing insecticidal protein to confer resistance against FSB. The cry1Ac gene is sourced from the soil bacterium *Bacillus thuringiensis* (Bt). When ingested by the FSB larvae, the Bt protein is activated in the insect's alkaline gut and binds to the gut wall, which breaks down, allowing the Bt spores to invade the insect's body cavity. The FSB larvae die a few days later.Bt Brinjal was developed by the Maharashtra Hybrid Seeds Company (Mahyco). The company used a DNA construct containing the cry1Ac gene, a CaMV 35S promoter and the selectable marker genes nptII and aad, to transform young cotyledons of brinjal plants. A single copy elite event, named EE-1, was selected and introduced into hybrid brinjal in Mahyco's breeding program. Mahyco also generously donated the Bt brinjal technology to the Tamil Nadu Agricultural University (TNAU), Coimbatore and University of Agricultural Sciences (UAS), Dharwad.

PRESENT STATUS OF BT BRINJAL

After imposing a moratorium of 10 years on commercial release of GM Bt brinjal, the Centre has allowed biosafety research field trials of 2 new transgenic varieties of indigenously developed Bt brinjal in 8 states during 2020-23 (Madhya Pradesh, Karnataka, Odisha, Bihar, Chhattisgarh, Jharkhand, Tamil Nadu and West Bengal). These indigenous transgenic varieties of brinjalare Janak and BSS-793 containing Bt Cry1Fa1 gene are developed by ICAR and NRCPB.

FARMER AND CONSUMER BENEFITS

Bt brinjal was found to be effective against FSB, with 98% insect mortality in Bt brinjal shoots and 100% in fruits compared to less than 30% mortality in non-Bt counterparts. The Multilocation Research Trials (MLRTs) confirmed that Bt brinjal required, on average, 77% less insecticides than non-Bt counterparts for control of FSB, and 42% less for the control of all insect pests of brinjal. The benefits of Bt brinjal, translate to an average increase of 116% in marketable fruits over conventional hybrids, and 166% increase over popular open-pollinated varieties (OPVs). Furthermore, the significant decrease in insecticide usage reduced the farmers' exposure to insecticides and results in a substantial decline in pesticide residues in brinjal fruits. Scientists have estimated that Bt brinjal will deliver farmers a net economic benefit ranging from Rs.16, 299 (US$330) to Rs. 19,744 (US$397) per acre with national benefits to India exceeding $400 million per year.

REGULATORY LADDER

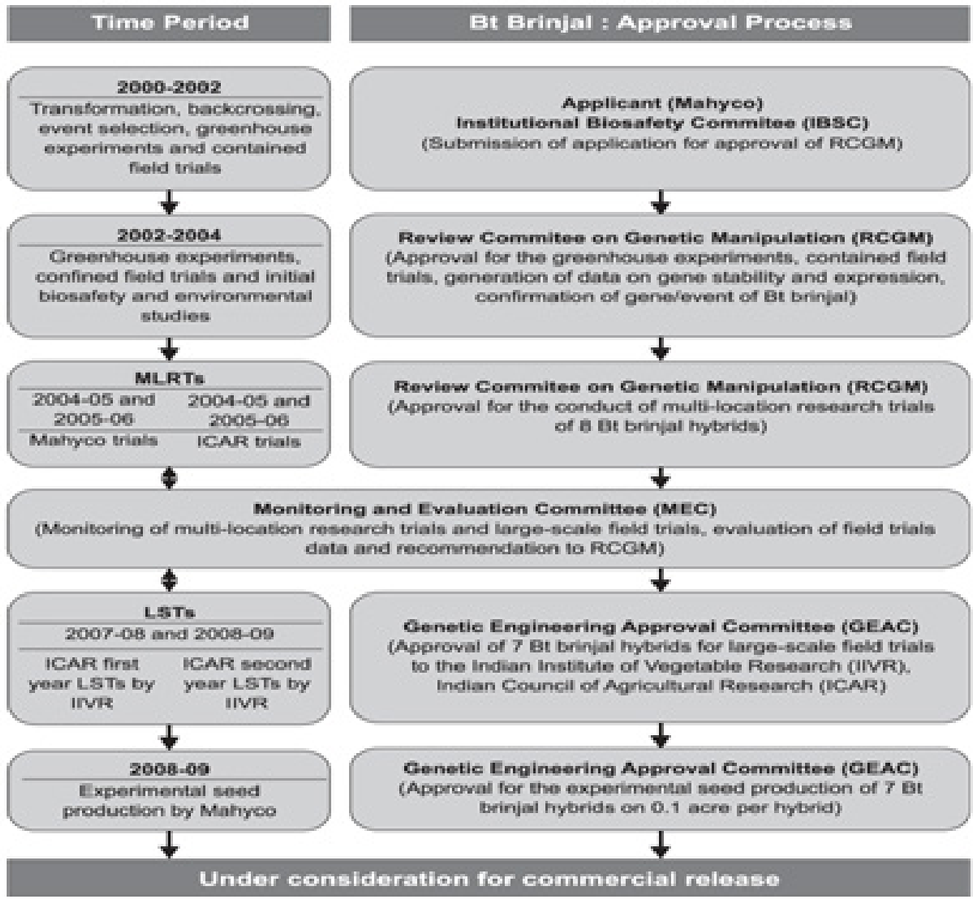

Figure 2: Protocol followed for the regulatory approval of Bt brinjal (ISAAA2008).

CONCLUSION

Bt brinjal has enormous potential to benefit both farmers and consumers. Results of studies submitted to regulatory authorities in India confirm that Bt brinjal offers the opportunity to provide effective control against fruit and shoot borer, and decrease insecticide input by as much as 80%. The adoption and acceptance of Bt brinjal by farmers and consumers in India will be a very important event from which the country and the world can benefit enormously.